

THE REPRODUCTIVE SEASONS OF SOME MAMMALS IN THE KRUGER NATIONAL PARK*

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INTRODUCTION

The Kruger National Park, some 7,340 square miles in extent, occupies the north eastern corner of South Africa between 22°25' and 25°32' latitude south and 30°50' and 32°2' longitude east. The area is covered by semi-arid bushveld vegetation and receives an annual rainfall ranging from 18-28 inches.

The larger mammals occurring in this area are also distributed in areas further north, most ranging as far as Kenya. Considering the extreme range of distribution, it may be expected that there will also be a corresponding variation in their breeding seasons. Most of the information published on this subject to date relates to the central regions of Africa, or comprise records from zoological gardens. It was, therefore, considered that the publication of our results, admittedly incomplete at this stage, may serve as a useful basis for comparison.

The terminology in this field is rather confusing. In this paper "reproduction" and "breeding" seasons are general terms, while "mating" and "calving" season denote the function under discussion.

TECHNIQUE

The results summarised here are observations made by the biological and ranger staff over the years, and are derived from records kept at Skukuza.

Not wanting to imply statistical accuracy where none exists, an attempt has been made to present the seasons schematically in weekly intervals. Calving seasons, where these exist, are indicated on the diagrams in solid black. Where no season is apparent, the available calving records are entered as blacked-in circles. This procedure is also followed in the case of unseasonal calves. Mating records are presented in the diagrams as circles.

Although the calving seasons, as presented here, are not statistically derived, they are accurate, and have been confirmed through repeated observation over the years.

The taxonomic status of the animals presented below is according to Meester and Davis (1964).

RECORDS OF INDIVIDUAL SPECIES

HERBIVORA

Loxodonta africana (Blumenbach) African Elephant.

The recording of reproductive data concerning the elephant is particularly difficult in the Kruger National Park. The breeding herds are shy and seldom allow prolonged periods of observation. Fig. 1 depicts the distribution of the meagre records available for this species.

At this stage we have no reason to doubt that the elephant here, as in Uganda (Perry 1952) and Zambia (Ansell 1960), have no fixed calving season.

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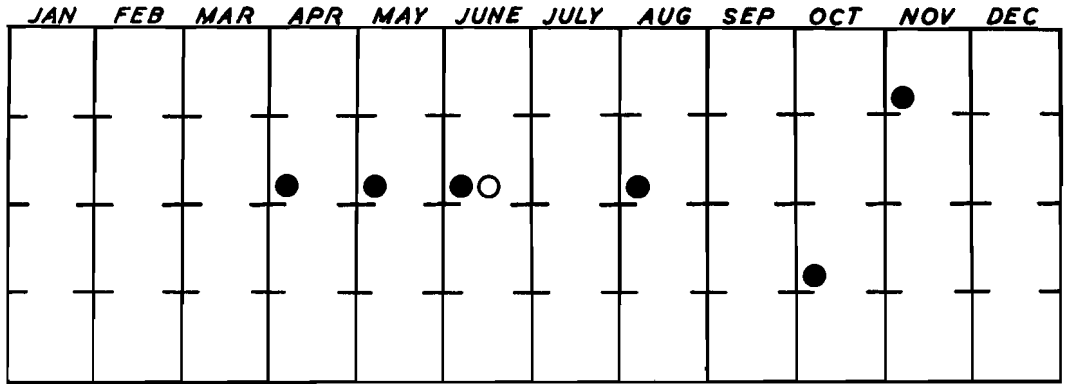


Fig. 1. *Loxodonta africana*

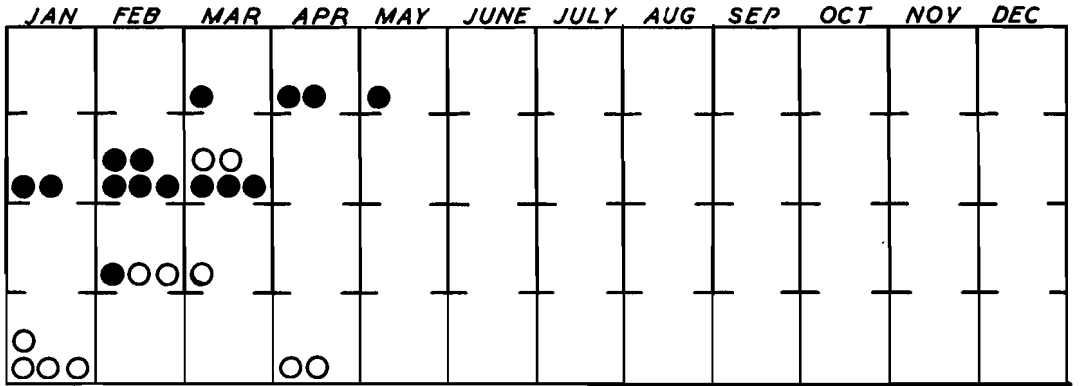


Fig. 2. *Syncerus caffer*

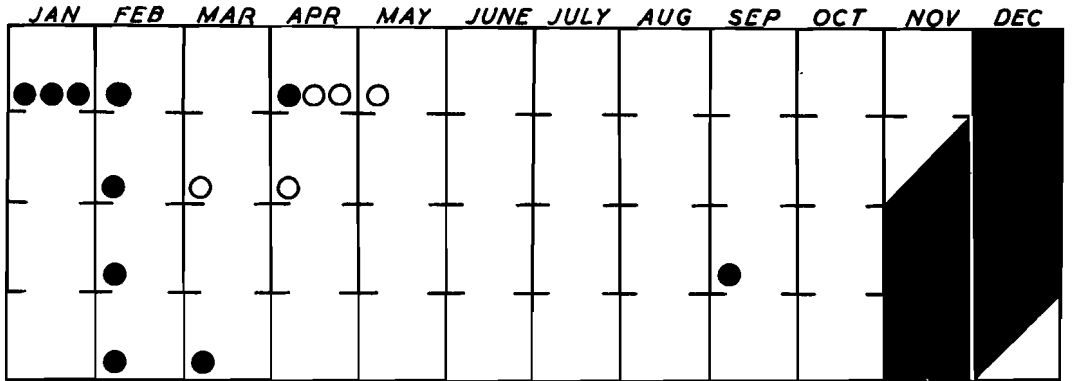


Fig. 3. *Connochaetes taurinus*

Syncerus caffer (Sparrman) African Buffalo.

In the past it was considered that buffalo had no specific calving season. In recent years, however, more accurate observation has changed this opinion radically. It is now apparent that buffalo calve in the period January to April, with the majority of calves being dropped in January and February.

In March, 1966, an experimental buffalo cropping scheme was initiated in the Park. From the material obtained here, an intensive study of the reproduction of this species has been undertaken. This study confirms the opinion expressed above with regard to a seasonal pattern of reproduction.

Mating takes place in March, April and May, and this also confirms that the calving season as specified is correct, the gestation period for buffalo being 330 days (Kenneth and Ritchie 1953).

Brand (1963) and Ansell (1960) report that there is no fixed calving season. Ansell, however, feels that there may be a peak period in the dry season, which corresponds with the winter months in East Africa.

Connochaetes (Gorgon) taurinus (Burchell) Blue Wildebeest.

This species has a definite calving season from the middle of November to the end of December. There are, however, local and seasonal deviations within this set pattern, evidently caused by variation in climatic and grazing conditions.

During the past two years serious drought conditions prevailed in the main wildebeest habitat of the Park. The effect of this drought was a protracted calving season, as well as a large number of unseasonal calves in January and February.

It seems, therefore, that although these animals exhibit an inherent rhythm in their breeding activities, this may be considerably influenced by prevailing climatic conditions.

The picture presented by the data from the National Zoological Gardens of South Africa (Brand 1963), is essentially the same as ours, calving commencing in November with a peak in December, and tailing off towards April.

The calves born late in February, March and April, are not as highly significant in our case, however, as they are few in relation to the total crop. Out of season births in the Park are generally regarded as exceptional occurrences.

Ansell (1960) and Talbot and Talbot (1963) present conflicting data for areas further north. The former author recording September and October in Zambia, while the latter report November to May, with a peak from January to March. Their data relates to Masailand.

If it is accepted that the stimulus for mating in these animals is the progressive shortening of the daylight period, Ansell's data are quite acceptable as they are derived from an area nearer the equator. It seems odd, however, that the calving seasons of these animals nearer the equator are of essentially the same duration as in our case. One would expect a more strictly defined season the further one moved from the equator.

Damaliscus lunatus lunatus (Burchell) Tsessebe.

The calving season of the tsessebe is very well demarcated, and our data exhibit a consistent

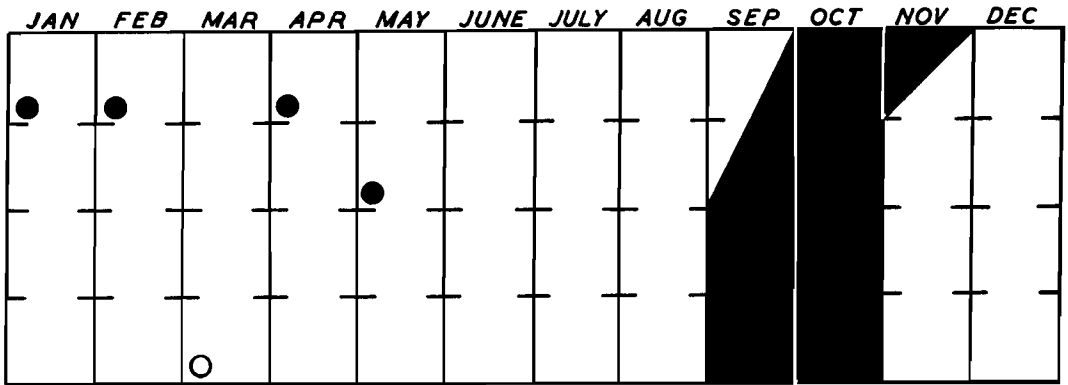


Fig. 4. *Damaliscus lunatus*

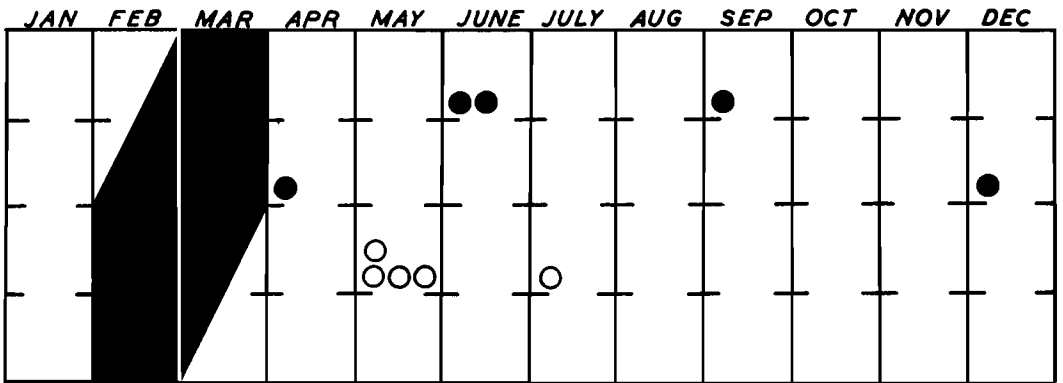


Fig. 5. *Hippotragus niger*

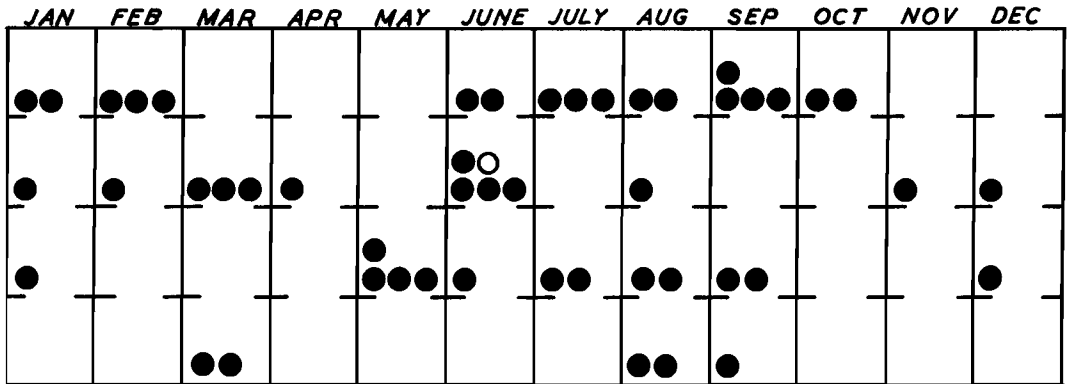


Fig. 6. *Hippotragus equinus*

trend. Young calves are of a much lighter colour and are easily identified as such, making for accuracy in age determination.

The out of season calves have all been reported during the last two years, and it is considered that this is directly attributable to the drought conditions prevailing here at this time.

In the case of the tsessebe, the calving season is also earlier in the more northern regions of Africa (Ansell 1960, 1963). In the Kruger National Park it appears that the calves are dropped over a shorter period than is the case further north.

Hippotragus niger niger (Harris) Sable Antelope.

Sable antelope in the Park also exhibit a well defined calving season in February and March. The newborn calves are of distinctive colouration and the period indicated here may be accepted as accurate.

Ansell (1960, 1963) records that in Zambia most births occur from June to September, but mentions data from Livingstone Game Park giving a season from January to March. This latter corresponds closely to our observations.

The earlier and more extended season in the northern parts of Zambia is not inconsistent in view of the fact that it is nearer to the equator.

Brand (1963) finds no calving season in his analysis. This emphasizes the danger of accepting zoo data without question.

Hippotragus equinus equinus (Desmarest) Roan Antelope.

Our data in respect of this species are inconclusive. As can be seen from Fig. 6 there is no clearly defined calving season, although the results seem to indicate more calves being dropped during the late autumn and winter months.

Ansell (1960) mentions that results for Zambia are too incomplete to formulate an opinion, but states that their records indicate the period April to August as the one of greatest calving activity. Blower (1961) is also of the opinion that there is no specific season in Uganda and Kenya.

Tragelaphus strepsiceros strepsiceros (Pallas) Greater Kudu.

Data assembled for this species indicates conclusively that there is a definite calving season from the middle of January to the end of February.

Brand (1963) reports essentially the same season in the Pretoria Zoological Gardens, while Ansell (1960) finds no sign of a calving season in Zambia. Wilson (1965) however, has accurate data for the eastern province of Zambia, indicating a peak of calving during January and February. He also mentions that Ansell now considers that his records might have been derived from older calves mistakenly reported as newborn due to subjective factors in age estimation.

An anomaly in our data relate to the observations of mating as indicated in Fig. 7. Kenneth & Ritchie (1953) give the gestation period of the kudu as 210 days. This would provide calving dates during October and November. Our calving season, however, is very definite and we have only one record of a calf in November and one in December.

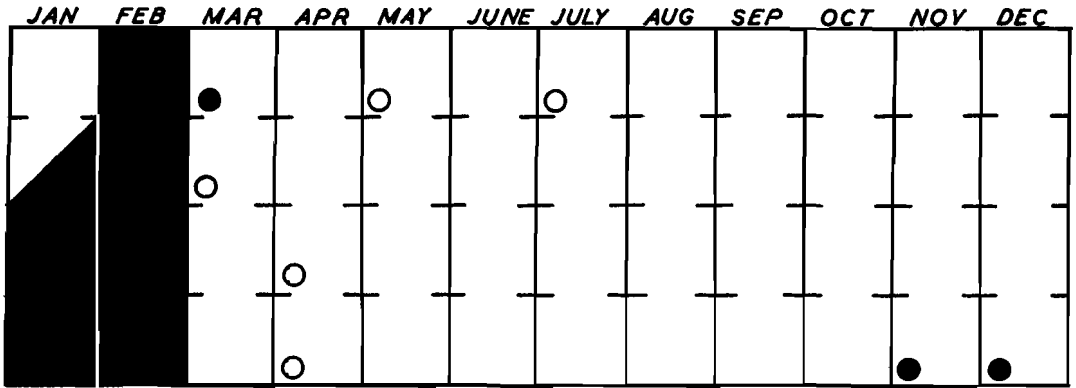


Fig. 7. *Tragelaphus strepsiceros*

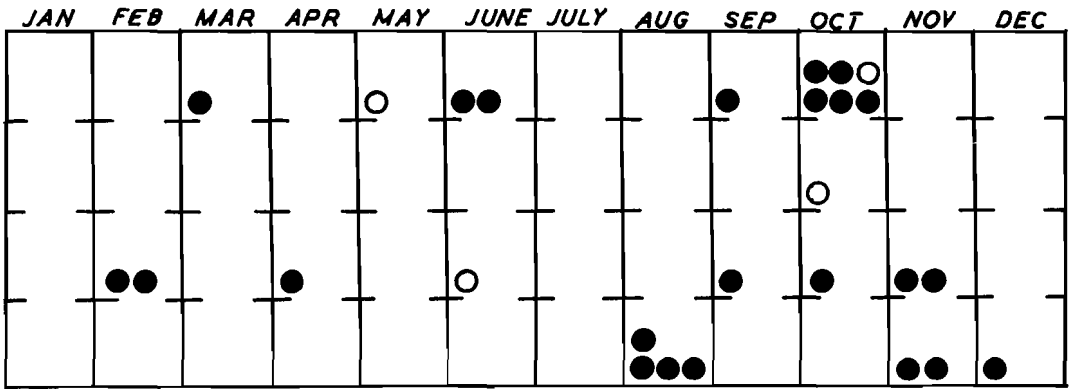


Fig. 8. *Tragelaphus angasi*

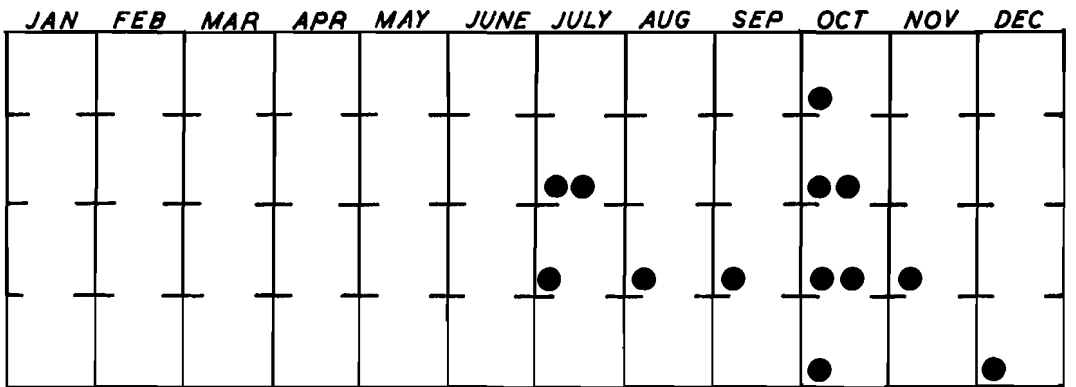


Fig. 9. *Tragelaphus scriptus*

Tragelaphus (Nyala) angasi Gray Nyala.

We do not have many records of newborn nyala, but the summary of our results in Fig. 8 seems to indicate that most young are born in the period August to November, with out of season lambs throughout the year.

Brand (1963) found nyala lambing throughout the year with a slight peak during the months September to December, roughly corresponding with our results. Stevenson-Hamilton (1947) also mentions the months September and October. As there were very few nyala in the Kruger National Park at this time, it is difficult to assess the validity of these observations.

In respect of this species, it is interesting to relate that Mr. H. H. Mockford of Pafuri, has a tame nyala ewe that has mated with wild rams roaming about in this part of the Kruger National Park. This animal had her first lamb in February, 1964, at an age of 18 months. Her next lamb was born in November, 1964, and the third in October, 1965. She was seen with a wild ram again one week after the last lamb was born.

Tragelaphus scriptus roualeyni (Gray) Bushbuck.

Although the bushbuck is by no means rare in the Park, we have not assembled much data. This is mainly due to the shy nature of these animals.

The records at our disposal indicate an extended season from July to November or December, with most lambing records during October.

Brand (1963) found that there was no fixed lambing season in Pretoria, young being born in practically every month of the year. Ansell (1960) does not think that there is any particular season in Zambia.

Taurotragus oryx (Pallas) Eland.

Despite the fact that we have not as yet acquired any great amount of data, our records for the eland show a definite calving season during August and September, practically all observations falling in this period. As can be seen in Fig. 10, the other observations also closely approximate this period. The single mating observation coupled to a gestation period of 255-270 days presents further corroboration for such a calving season.

Brand (1963) reports calves at all times of the year, but his data indicates a peak during the period July to November. This seems also to conform with our observations.

The data presented by Ansell (1960) is confusing, but would appear to indicate a possible calving peak during the period June to August. This is close to our own observation, although slightly earlier as his data are from further north.

Aepyceros melampus melampus (Lichtenstein) Impala.

Impala occur in large numbers in the Kruger National Park, and being easily seen, our knowledge of their reproductive pattern is fairly complete.

These animals have a fixed lambing season, commencing during the beginning of November and lasting right through December. Lambs have been reported at the end of October and during January. These are considered, however, as exceptions to the rule.

As can be seen in Fig. 11, quite a number of out of season lambs have been reported. This is to be expected, however, in a population of such size as we have here.

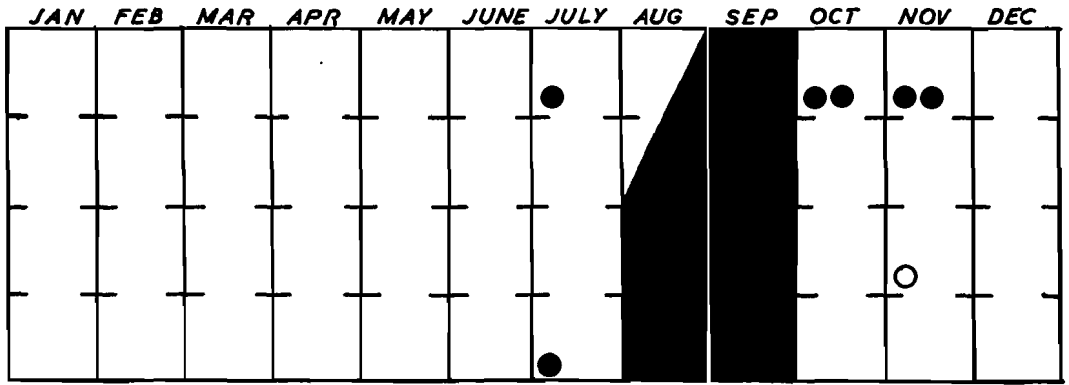


Fig. 10. *Taurotragus oryx*

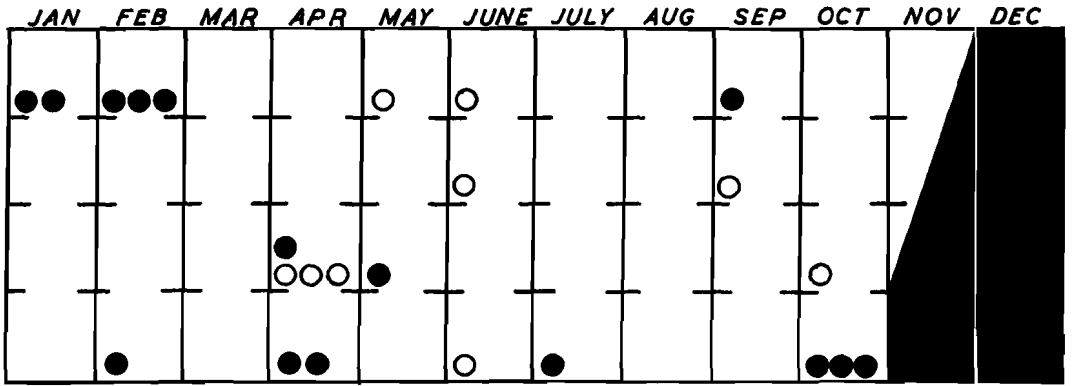


Fig. 11. *Aepyceros melampus*

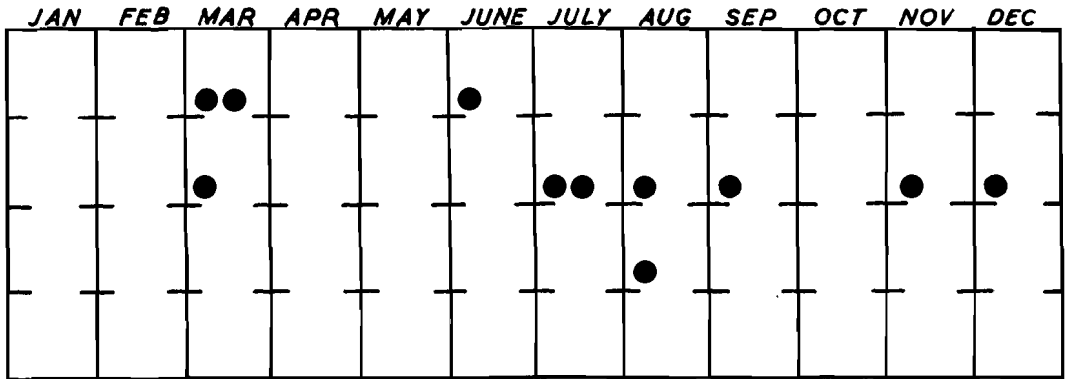


Fig. 12. *Redunca arundinum*

The mating season commences at the end of April and lasts until the beginning of June, occasionally extending to the middle of June.

Lambing within the defined season varies as well. During some years lambing commences early and is concentrated during a shorter period, whereas during other years it is delayed and more dispersed throughout the season. More out of season lambs are also reported during abnormal years or in areas where grazing conditions have been disrupted.

From data obtained in the Pretoria Zoological Gardens, Brand (1963) depicts essentially the same lambing season as the one experienced here. Ansell (1960) maintains that the lambing season of impala in Zambia is from September to October and November. He also mentions that the season in the Luangwa Valley occurs during October and November, while in Wankie it lasts from November to December, patently the same as in our case. Dasmann and Mossman (1962) state that the lambing season of these antelope in Southern Rhodesia occurs during December, while the mating season lasts from mid May to mid June.

Histologically the testes of male impala show activity throughout the year, sperm being present in the testes and epididymis at all times. Yet it seems possible that the degree of activity varies throughout the year, there being some evidence from the work at present being undertaken in the Park, that the sperm are less viable during periods outside the mating season.

This observation seems to be confirmed by the work of Kerr (1965) who finds a difference in the weight of testes from adult rams during different months of the year, the heaviest being obtained near the start of the mating season. He also finds that impala rams are physiologically capable of fertilization at 13 months of age, in other words, shortly before the commencement of the mating season of the year following their birth.

From results obtained in an intensive study of impala reproduction, it seems as if the female has more than one oestrus cycle only in exceptional cases.

Redunca arundinum arundinum (Boddaert) Reedbuck.

Data in respect of the reedbuck is meagre; observations of new born lambs have been made at all seasons as may be seen in Fig. 12.

Both Brand (1963) and Ansell (1960) find no indication of a season in the analysis of their data, and all the authors quoted by them, seem to feel that a protracted lambing period is the rule in this species.

Redunca fulvorufula fulvorufula (Afzelius) Mountain Reedbuck.

The mountain reedbuck is one of the rare antelope species of the Kruger National Park, and for the most part it inhabits difficult mountainous terrain.

We have to date recorded very few observations of young lambs. The results at our disposal are presented in Fig. 13. It will be realised that one can draw no valid conclusions from such data. It is perhaps significant that most of the observations are during the spring and summer seasons. Brand (1963) also finds most young during the summer months.

Kobus ellipsiprymnus ellipsiprymnus (Ogilby) Waterbuck.

Waterbuck in the Park have a calving season as indicated in Fig. 14 and although our data does not indicate it clearly, there is evidence of a second peak in the early spring. The seasons

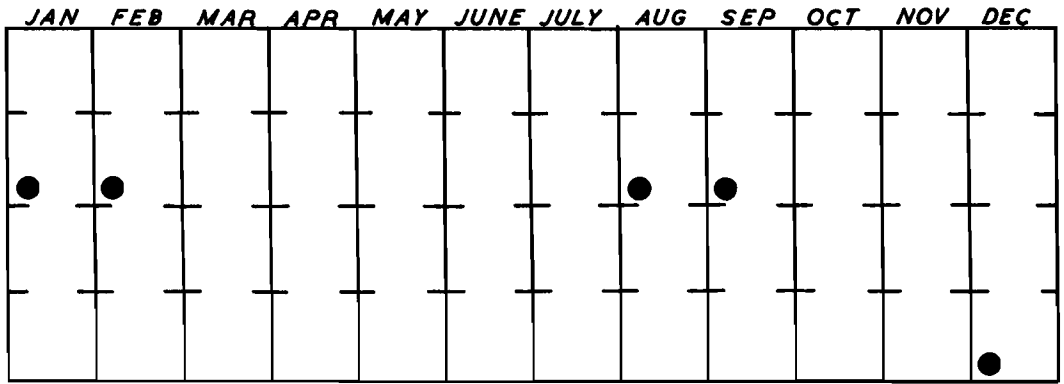


Fig. 13. *Redunca fulvorifula*

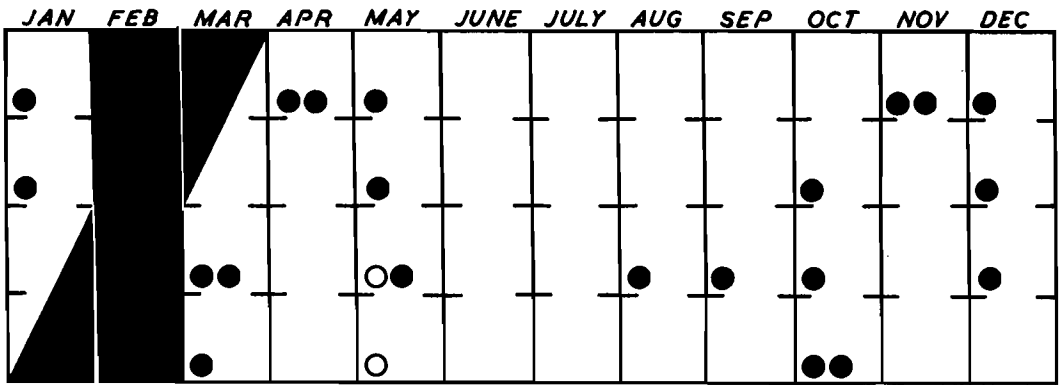


Fig. 14. *Kobus ellipsiprymnus*

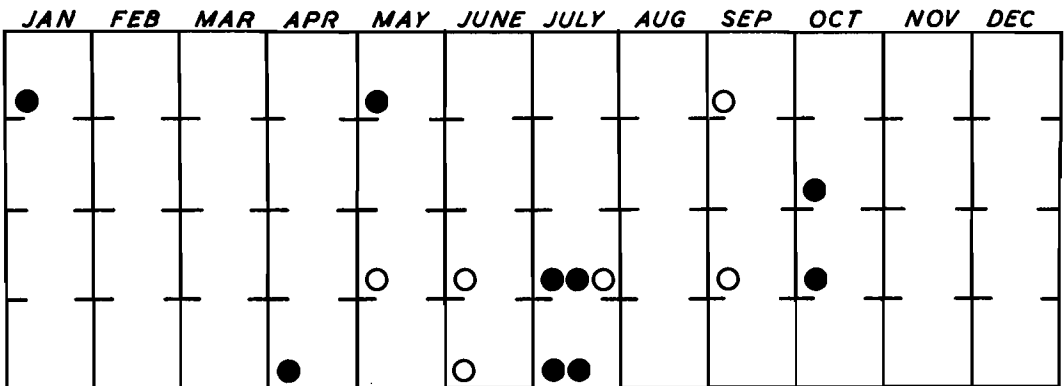


Fig. 15. *Raphicerus campestris*

are not as clearly demarcated as in the case of other seasonal animals and this season may be referred to as peak periods in a more protracted calving period comprising the summer months.

The information presented by Brand (1963) also indicates a peak of calving during January, February and March, with calves occurring at all other seasons as well. Ansell (1960) recorded calves throughout the year. His number of observations are too small, however, to allow definite conclusions. Dasmann and Mossman (1962) state that in Southern Rhodesia waterbuck are seasonal breeders, calves being dropped in February and March. From older records, Stevenson-Hamilton (1947), it also seems as if February was taken as the peak in an irregular season.

Raphicerus campestris capricornis Thomas and Schwann. Steenbok.

Steenbok are common in the Kruger National Park. Their young, however, are hidden for some time after birth, making the collection of lambing data difficult.

As can be seen from Fig. 15, our lambing observations occur during late autumn, winter and spring, while our mating records also follow the same pattern.

The mating records at our disposal are accurate and can be used to determine the lambing season if the gestation period is known. This period is not, however, clearly established. Kenneth and Ritchie (1953) give the period as 210 days. This is quoted from Wilhelm (1933) and is obviously incorrect, as Bigalke (1963) has demonstrated that gestation cannot last for more than 168 days.

Accepting a gestation period of approximately 5 months, our mating data would indicate a lambing season in the spring.

It seems, therefore, that although births have been recorded during the winter months and the main season may follow in spring, more information is necessary for this species.

Raphicerus melanotis sharpei Thomas Sharpe's Steenbok.

These little antelope are not common in the Park and are very timid, breeding records are consequently hard to come by.

The following have been recorded: a lamb of about 2 months in September; an injured female that lambed in July, the lamb being stillborn, and a full term foetus in May.

Ansell (1963) mentions a birth record for July and foetal records in May, October and November.

Sylvicapra grimmeia caffra Fitzinger. Grey Duiker.

This species again is rather shy and breeding data is scarce. It would appear that most lambs are born during the winter, but we have not as yet enough records to be certain.

In June a female was found in lactation and carrying a large foetus. It seems likely therefore that this species may produce two lambs a year in our area. Bigalke (1963) has also reported that steenbok are capable of raising two lambs a year.

Brand (1963) finds that although most young are born during the summer months, duiker lamb throughout the year. Ansell (1960 and 1963) corroborates these findings and also mentions a lactating female with a foetus. Riney and Child (1960) also record that lambing takes place throughout the year, but mention two peaks that coincide with the middle of the rainy

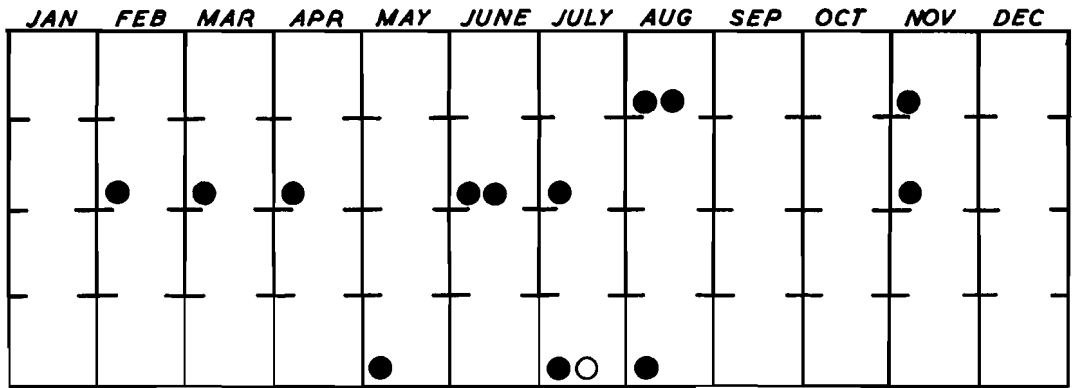


Fig. 16. *Sylvicapra grimmia*

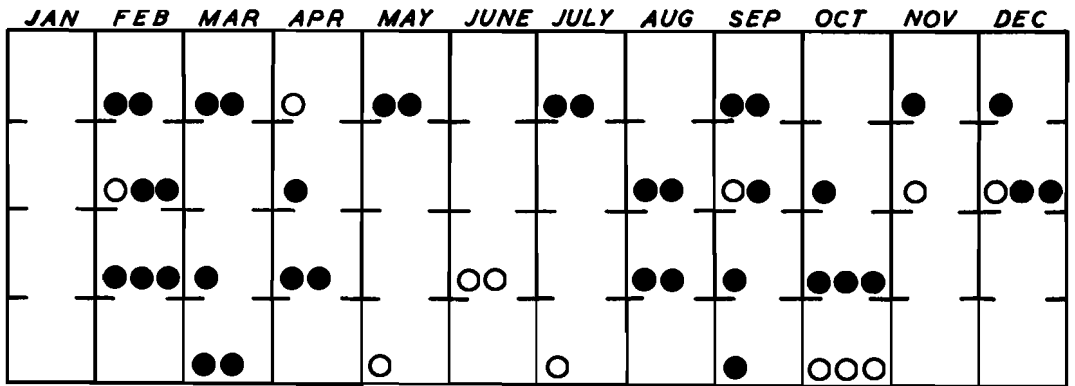


Fig. 17. *Giraffa camelopardalis*

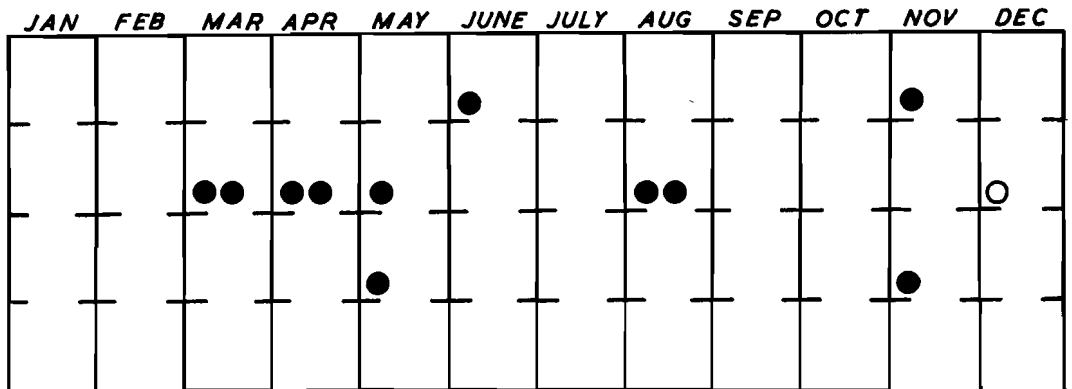


Fig. 18. *Ceratotherium simum*

season and the middle of the dry season. Their results are based on a large number of skulls obtained from tsetse control operations.

Oreotragus oreotragus transvaalensis Roberts. Klipspringer.

In the case of the klipspringer, we have records of lambs in November (1) and December (1), while mating behaviour was observed in July.

These results are inconclusive and considering the lack of data in the literature, special attention should be paid to this species.

Giraffa camelopardalis giraffa (Boddaert) Giraffe.

Giraffe in the Kruger National Park appear to have two definite peaks in their calving, one during the months February to March, and the other during August, September and October. The observations outside these periods may well be observations of older calves as it is by no means easy to determine the age of a young giraffe in the veld.

Ansell (1960) finds no definite calving season for giraffe in Zambia, but quotes other authors mentioning the months October and March.

The fact that two peaks were not as clearly indicated as in our data, might have influenced these authors in believing that giraffe calve throughout the year.

Ceratotherium simum simum (Burchell) Square-lipped Rhinoceros.

Square-lipped Rhinoceros have only recently been re-introduced to the Kruger National Park, and consequently we have limited data concerning their calving season. This data, however, constitutes the record of every known calf to date.

Fig. 18 presents the information at hand and it is quite evident that no conclusions can be drawn at this stage.

Player and Feeley (1960) report no season for this species, but find that females in oestrus are most frequently seen from July to September.

Equus (Hippotigris) burchelli antiquorum H. Smith. Burchell's Zebra.

In the Kruger National Park zebra foal from September to March. There is, however, a peak during the period November to February.

Brand (1963) states that in the National Zoological Gardens at Pretoria, zebra seem to have no specific season. His data, however, also appears to indicate a peak during January and February.

The results Ansell (1960) obtained in Zambia are interesting in that he finds a distinct season from March to October, with a peak during July and August. This is exactly opposite to the season experienced locally.

Klingel (1965) provides accurate data for the Ngorongoro crater in Tanzania. He finds a foaling season from October to March, with a peak in January and February. This confirms our observations and makes Ansell's data difficult to explain.

In horses the reproductive cycle is controlled by an increase in the photoperiod, in contrast to the ruminants, where it is regulated by a decrease in the amount of daylight. It would appear from the available data as if this is also the case with zebra, and this fact also tends to invalidate Ansell's findings for zebra in Zambia.

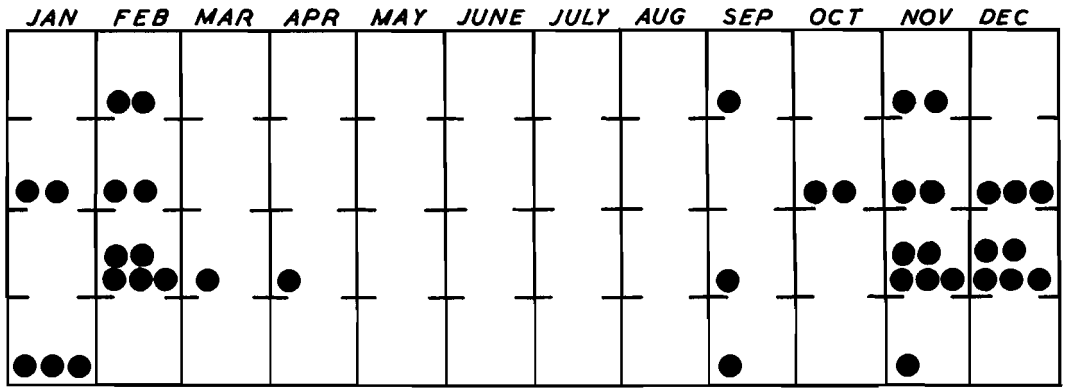


Fig. 19. *Equus burchelli*

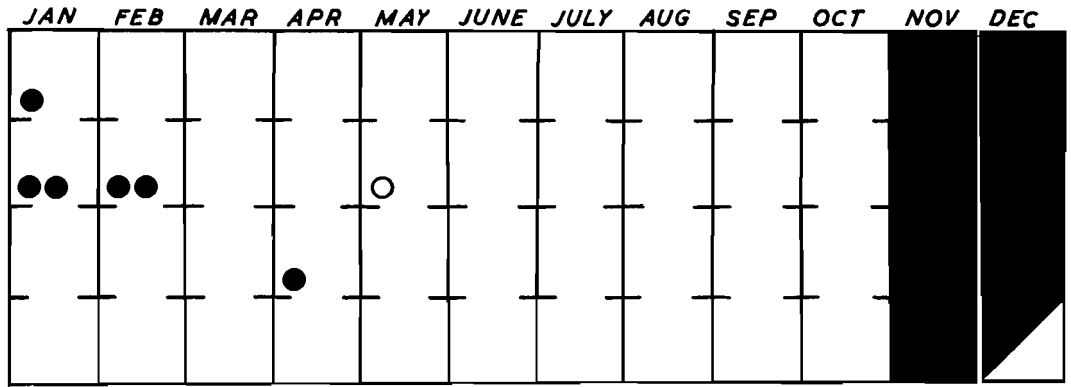


Fig. 20. *Phacochoerus aethiopicus*

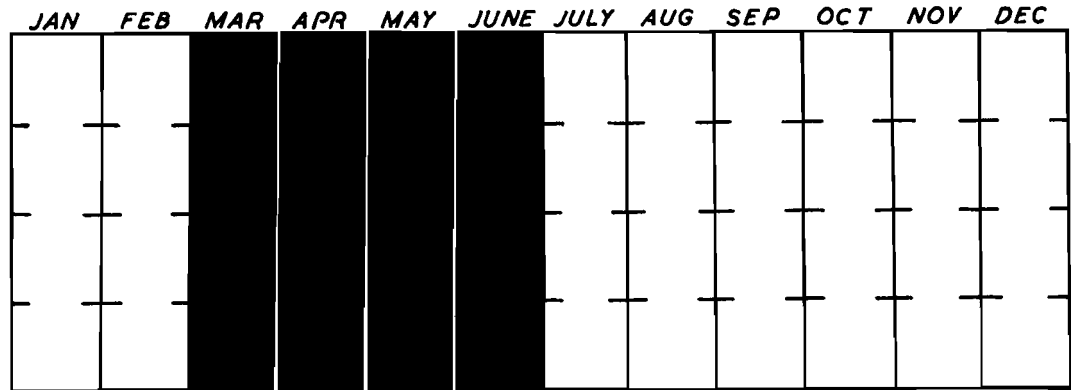


Fig. 21. *Hippopotamus amphibius*

Out of season foals are reported by all authors and this is also experienced in the Kruger National Park.

Phacochoerus aethiopicus sundevalli Lönnberg. Warthog.

The warthog has a definite farrowing season in November and December. The piglets reported in January and February were possibly farrowed during this period, but only reported later. As out of season young are common in most of our animals, however, it is not impossible that they fall in this category.

Quoting records from the National Zoological Gardens, Brand (1963) reports a reasonably strict season from July to October, with a few litters during November and December. These results are difficult to interpret, but most likely reflect the different conditions under which these animals are kept.

Ansell (1960) finds that the farrowing season of warthog in Zambia is consistently earlier than in our case, being July to September for the north western province and October to November in the Luangwa Valley.

These results are to be expected in view of the fact that Zambia is much nearer the equator than we are. Ansell also mentions that in areas further north, the seasonal pattern tends to disappear, and theorizes that this is because of the proximity of these regions to the equator.

Hippopotamus amphibius capensis Desmoulins. Hippopotamus.

Due to the fact that hippopotami frequent an aquatic habitat and are very protective towards their young, we, at one stage, had very little data concerning the reproduction of these animals. It was considered that hippopotami calved throughout the year.

During the months of May to August, 1964, officials of the Nature Conservation Division in the Kruger National Park undertook an experimental cropping scheme, whereby one hundred hippo were shot. These animals presented a random sample of the population (Pienaar et al. 1966). In the analysis of data forthcoming from this project, it was concluded that this species has a definite calving season in the Park. Young hippo are born from January to July, with a peak during the period from March to June.

These observations, while not conclusive, are interesting and will be continued during the calving period.

The observations of new born calves we have, are for March (1), April (2) and May (2). Mating was observed during June, July and August. With a gestation period of 8 months, this all tends to confirm the seasons as we have described them.

Other authors seem agreed that this species breeds throughout the year (Ansell 1960, Brand 1963). Laws (1963), however, finds in data from a culling operation that the mating season in Queen Elizabeth Park is between January and April, when 76% of conceptions occur. This provides a peak calving period in Uganda from September to December. Laws also mentions that calves are born throughout the year.

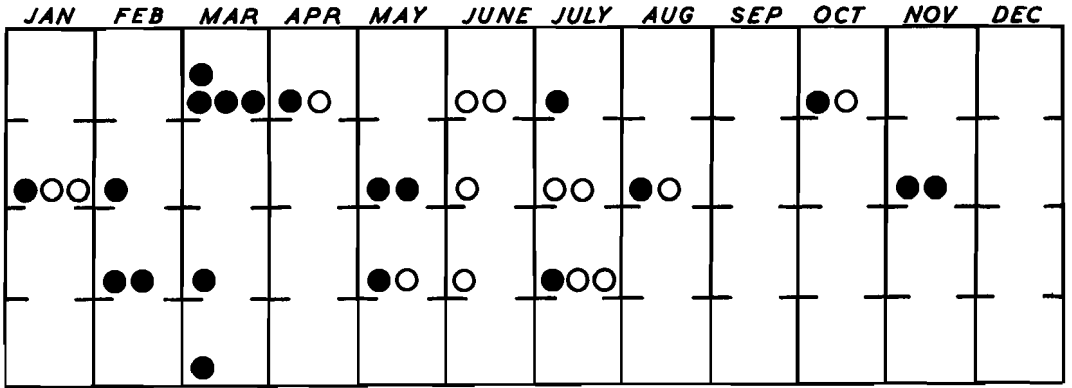


Fig. 22. *Panthera leo*

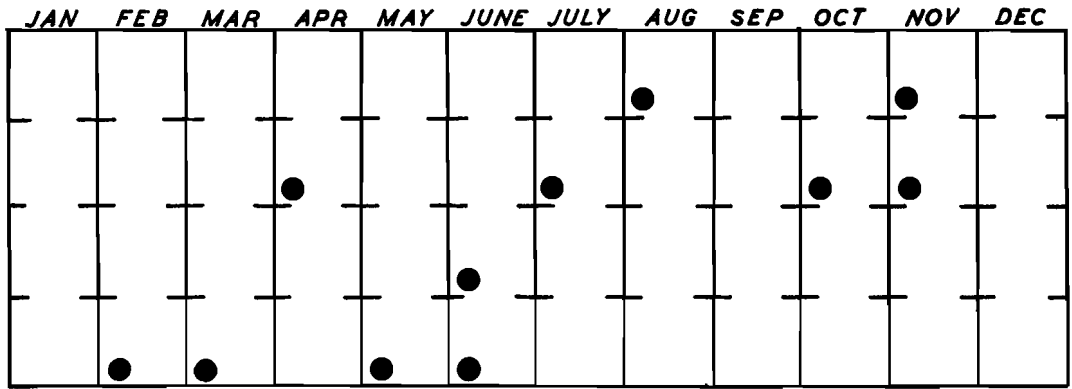


Fig. 23. *Panthera pardus*

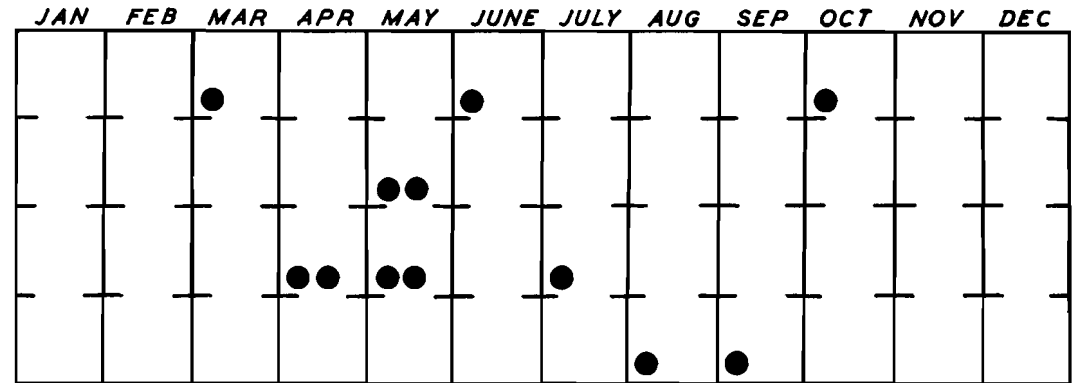


Fig. 24. *Acinonyx jubatus*

CARNIVORA

Panthera leo krugeri (Roberts) Lion.

As may be seen from Fig. 22, it would appear as if lions breed throughout the year. This is also the condition found by Brand (1963) and Ansell (1960), as well as other authors quoted by them.

The general impression in the Kruger National Park is that most litters are born during the autumn and winter months as is shown in Fig. 22. This, however, is also the time when most mating is observed. The apparent anomaly may possibly be explained by the seasonal distribution of our lion population, most animals being observed during the winter months.

Panthera pardus pardus (Linnaeus) Leopard.

Our data for the leopard shows no specific breeding season. There may be peaks in the winter and spring as reported by Stevenson-Hamilton (1947), but at this stage we have too little information to draw conclusions.

Other authors all find that young are born throughout the year.

Acinonyx jubatus jubatus (Schreber) Cheetah.

The cheetah is of all the large carnivores, the rarest in the Park and it is distressing that so little is known about them.

The observations recorded in Fig. 24 seem to indicate that the young are born during the autumn and winter months, but the data is inconclusive.

Lycaon pictus pictus (Temminck) Cape Hunting Dog.

Data concerning wild dog, while not complete, indicates late autumn and winter as the season when most pups are born. The observations during October are difficult to interpret, but evidently constitute a second peak of whelping activity.

Brand (1963) indicates a peak season from March to June, with other births in August, October and November. Ansell (1960) gives the period for Zambia as from May to July. These results confirm our own observations which are accurate, as most of the warrens where these animals have their young are well known and regularly visited.

The domestic dog is said to mate in the early spring and autumn, giving two whelping seasons (Asdell 1946). This information closely conforms to what we find here.

Canis mesomelas mesomelas Schreber. Black-backed Jackal.

Although incomplete, our observations on this species indicate a whelping season in August, September and October.

Brand (1963) finds a similar season from his records.

Crocuta crocuta (Erxleben) Spotted Hyaena.

The data in Fig. 27 again indicate that although the spotted hyaena whelps throughout the year, there seems to be a peak of activity during the winter months. Once again, however, there are too few observations to give an accurate assessment.

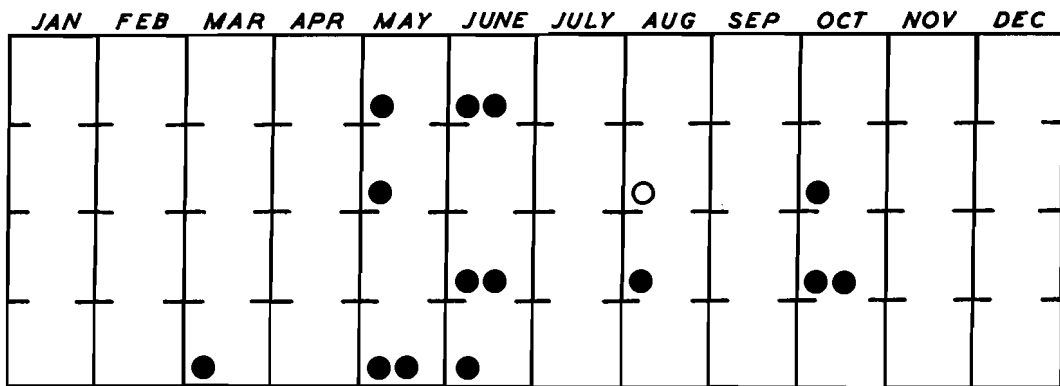


Fig. 25. *Lycaon pictus*

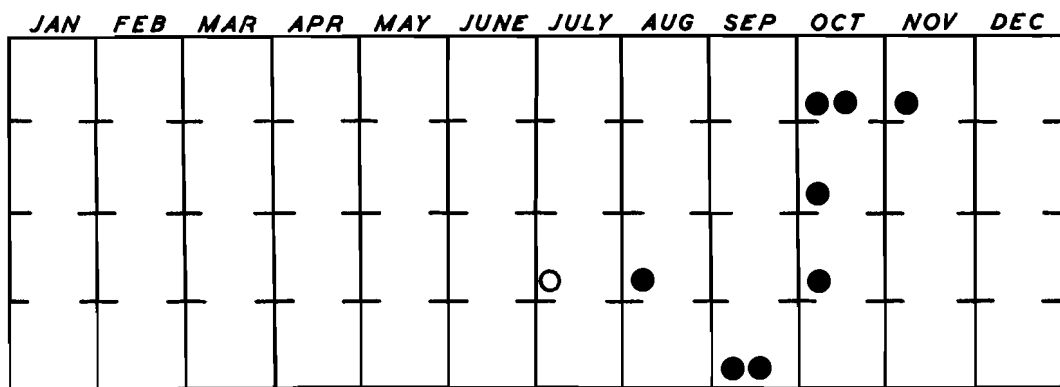


Fig. 26. *Canis mesomelas*

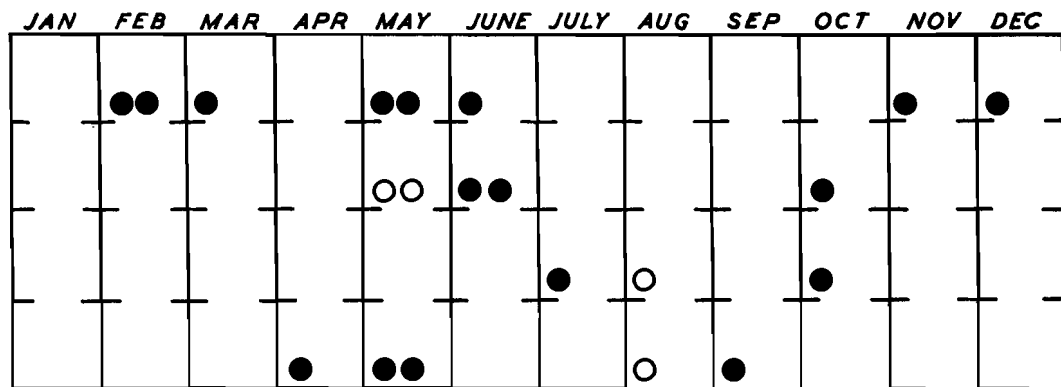
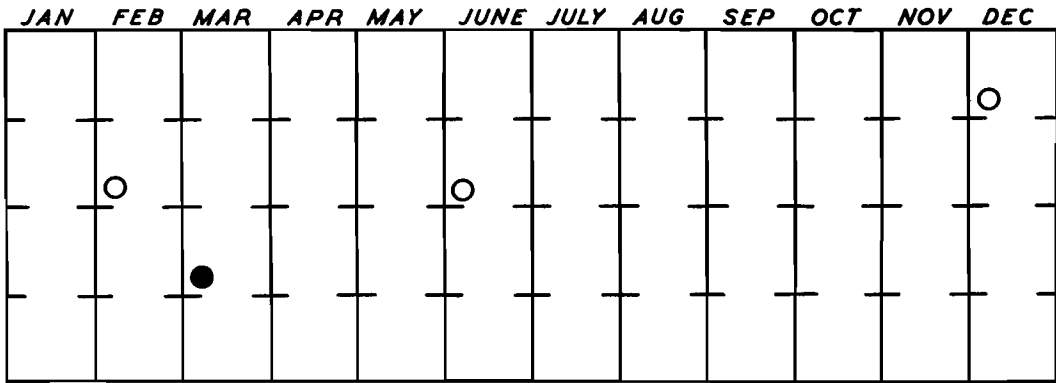


Fig. 27. *Crocuta crocuta*

Fig. 28. *Mellivora capensis*

Mellivora capensis capensis (Schreber) Honey Badger.

Data for the honey badger are incomplete, but the mating records indicate that they breed throughout the year.

Brand (1963) has one record of young born in February.

MISCELLANEOUS BREEDING RECORDS

For the following species records are incomplete and only the relevant observations are recorded.

Felis caracal caracal Schreber. Caracal.

Caracal cubs have been seen in January (1), February (1), May (1) and November (1).

Felis (Leptailurus) serval hamiltoni Roberts. Serval Cat.

Cubs have been seen in August (1) and June (1).

Felis sylvestrus caffra Desmarest. African Wild Cat.

Wild cat cubs have been seen in December (1) and a case of hybridization with a domestic Siamese cat occurred at Shingwedzi.

Viverra (Civettictis) civetta australis Lündholm. Civet.

Young civets have been seen in November (1), December (1) and August (1).

Genetta tigrina rubiginosa Pucheran. Russet spotted Genet.

Three new born cubs were found in February.

Helogale parvula parvula (Sundevall) Dwarf Mongoose.

Cubs have been found in January.

Hystrix africae australis Peters. Porcupine.

Baby porcupines have been seen in April (2) and May (2). Mating has also been observed during May.

DISCUSSION

SEASONAL BREEDING PATTERNS

Most mammals display an inherent seasonal rhythm in their breeding. This is genetically determined and is governed by internal factors such as the endocrines.

The timing of this rhythm is dependent however on external triggering stimuli (Amoroso and Marshall 1962). It is this last condition that is of importance in the determination of the breeding seasons with which we are dealing in this paper.

Amoroso and Marshall (1962) find that the most important external stimuli are light regime, nutritional state and temperature. Talbot et al. (1965) state that the timing and success of breeding is largely determined by nutrition, but mention that variations in duration and intensity of light also effect the timing of the season.

It is clear that both these factors i.e. nutrition and light regime, are of major importance in determining the seasonal rhythm. It is difficult to decide which plays the major role.

Talbot and Talbot (1963) feel that in the case of the wildebeest in Masailand, the state of nutrition is the main factor. As this area is nearer the equator and the calving season is later than ours, it does appear likely.

In our case, however, we find that some of the strictly seasonal breeders calve at about the worst time of the year from a nutritional point of view, viz. eland, tsessebe and hippopotamus, while many others calve towards the end of summer, when grazing conditions are definitely not at their best. Estes (1966) mentions that the topi, *Damaliscus korrigum*, also calves at the height of the dry season in Northern East Africa. He reasons that nutritional conditions are optimum then, as *Damaliscus* spp. prefer cured grass. This is not entirely correct, as cured grass can never be compared to the fresh product as far as nutrition is concerned.

The main wet season in most of the semi-arid regions of South and East Africa is during the summer months, viz. November to March. On the whole our calving periods in the Kruger National Park are later than those reported for the more northerly regions of Africa. Also certain animals which display seasonal patterns here, do not exhibit such patterns in East Africa. The most feasible explanation for this is that the mating season is determined by the photoperiod, ruminants reacting to a period of decreasing light and equines to period of increasing light.

In stating this fact, it must be remembered that our rainfall is also correlated with the photoperiod as this is coupled to the changing of the seasons.

Additional evidence which inclines towards this view, is the experimental work that has been done in this direction. Sheep, for instance, under constant nutritional conditions have had their seasons reversed solely by manipulation of the light regime (Yeats 1949). Experiments of this nature have been conducted by numerous workers on a wide variety of animals, as may be seen in any standard textbook on reproduction. Sheep have also had their seasons modified by changing from the Northern to the Southern hemisphere and vice versa, and the same condition holds for wildebeest, impala and others with a strict calving season in the Kruger National Park. When these animals are kept in zoological gardens in Europe, their seasons adapt to the light regime of the Northern hemisphere.

Nutrition has a definite effect on the calving pattern within a season, determining such phenomena as dispersal of calving within the season. From our results, it would appear as if young are dropped early and during a shorter period in good years, whereas they arrive later and more dispersed during drought periods. Estes (1966) found in the Makarikari area of Bechuanaland that a severe drought modified the season of wildebeest considerably. These

observations, however, require further study.

SOURCES OF REFERENCE

It will be noticed that references to older authors have been utilized sparingly. It was considered that these older workers were often unwittingly inaccurate and misleading. The data they had to hand was often assembled by individuals who had little knowledge of the implications thereof, and in some cases, totally inaccurate, viz. Wilhelm (1933) on the gestation period of the steenbok. For those interested in such earlier works, reference may be found in the publications of Ansell (1960) and Brand (1963).

DATA FROM ZOOLOGICAL GARDENS

Although data from these sources are invaluable, the fact that some observations here do not coincide with those under natural conditions, makes it imperative that they be analysed with care. The animals are kept under abnormal conditions, and the results can at times be misleading.

SUBJECTIVITY IN AGE DETERMINATION

In the case of many of our larger mammals, the young animals grow relatively slowly and subjective errors in age determination are common as evidenced for instance in our previous opinion that the buffalo had no fixed calving season.

This subjectivity in age determination also occurs throughout our range of species to a greater or lesser degree and is most likely the cause of a number of out of season births recorded in this publication.

A standard method of visually categorizing animals into an under one month age group at least, is essential. Mr. W. H. F. Ansell has put forward a scheme which should greatly help in this respect. It can only be recommended that this be accepted and improved through use by all workers in this field.

ACKNOWLEDGEMENTS

To the ranger staff of the Kruger National Park, past and present, most of the credit for this publication is due. Without the faithful return of their observations, it would not have been possible.

The Biological staff, especially Dr. U. de V. Pienaar, also contributed in no small degree to the records given herein.

Thanks are also due to Dr. Pienaar for reading the manuscript and making numerous suggestions.

SUMMARY

The calving seasons of the larger mammals in the Kruger National Park are presented diagrammatically and discussed in relation to other published records.

Events influencing the reproduction patterns are analysed in the light of modern literature. In most work on periodicity in game the opinion exists that nutrition, which is dependent on rainfall, is the main factor. From the results presented in this paper, it is reasoned that light regime has the major influence, nutrition affecting the calving pattern within the season.

Mating records are presented where available, as well as data on some of the smaller mammals.

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